On two speed optimization problems for ships that sail in and out of emission control areas - DTU Orbit (08/11/2017)

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This paper deals with two speed optimization problems for ships that sail in and out of Emission Control Areas (ECAs) with strict limits on sulfur emissions. For ships crossing in and out of ECAs, such as deep-sea vessels, one of the common options for complying with these limits is to burn heavy fuel oil (HFO) outside the ECA and switch to low-sulfur fuel such as marine gas oil (MGO) inside the ECA. As the prices of these two fuels are generally very different, so may be the speeds that the ship will sail at outside and inside the ECA. The first optimization problem examined by the paper considers an extension of the model of Ronen (1982) in which ship speeds both inside and outside the ECA are optimized. The second problem is called the ECA refraction problem, due to its conceptual similarity with the refraction problem when light travels across two different media, and also involves optimizing the point at which the ship crosses the ECA boundary. In both cases the objective of the problem is to maximize daily profit. In addition to mathematical formulations, examples and sensitivity analyses are presented for both problems.

General information

State: Published
Organisations: Department of Management Engineering, Norwegian University of Science and Technology
Authors: Fagerholt, K. (Ekstern), Psaraftis, H. N. (Intern)
Pages: 56-64
Publication date: 2015
Main Research Area: Technical/natural sciences

Publication information

Journal: Transportation Research. Part D: Transport & Environment
Volume: 39
ISSN (Print): 1361-9209
Ratings:
BFI (2017): BFI-level 2
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 2
Scopus rating (2016): CiteScore 3.08 SJR 1.195 SNIP 1.573
Web of Science (2016): Indexed yes
BFI (2015): BFI-level 2
Scopus rating (2015): SJR 1.143 SNIP 1.379 CiteScore 2.65
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 2
Scopus rating (2014): SJR 1.427 SNIP 1.953 CiteScore 2.49
Web of Science (2014): Indexed yes
BFI (2013): BFI-level 2
Scopus rating (2013): SJR 1.213 SNIP 1.663 CiteScore 2.08
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 2
Scopus rating (2012): SJR 1.061 SNIP 1.705 CiteScore 2
ISI indexed (2012): ISI indexed yes
BFI (2011): BFI-level 2
Scopus rating (2011): SJR 0.962 SNIP 1.72 CiteScore 1.86
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
BFI (2010): BFI-level 2
Scopus rating (2010): SJR 0.732 SNIP 1.317
Web of Science (2010): Indexed yes
BFI (2009): BFI-level 2
Scopus rating (2009): SJR 0.835 SNIP 1.453
BFI (2008): BFI-level 2
Scopus rating (2008): SJR 1.041 SNIP 1.326
Scopus rating (2007): SJR 0.776 SNIP 1.596
Scopus rating (2006): SJR 0.815 SNIP 1.827

Scopus rating (2005): SJR 0.774 SNIP 1.661
Scopus rating (2004): SJR 0.542 SNIP 1.372
Scopus rating (2003): SJR 0.995 SNIP 1.91
Web of Science (2003): Indexed yes
Scopus rating (2002): SJR 0.556 SNIP 1.462
Scopus rating (2001): SJR 0.583 SNIP 1.58
Scopus rating (2000): SJR 0.743 SNIP 1.027
Scopus rating (1999): SJR 0.491 SNIP 1.202
Original language: English
Maritime transportation, Speed optimization, Emission control areas
Electronic versions:
On_two_speed_optimization_problems_for_ships_that_sail_in_and_out_of_emission_control_areas_Revision_1_May_2015.pdf
DOIs:
10.1016/j.trd.2015.06.005
Source: FindIt
Source-ID: 2279673021
Publication: Research - peer-review › Journal article – Annual report year: 2016